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second user computing devices edit a document concurrently in accordance with the principles of the present disclosure; and

[0023] FIGS. 27-31 illustrate changes to an exemplary user interface of a first authoring application as a first user and a second user collaboratively author a document in accordance with the principles of the present disclosure.

DETAILED DESCRIPTION

[0024] In the following detailed description, references are made to the accompanying drawings that form a part hereof, and in which are shown by way of illustrations specific embodiments or examples. While the disclosure will be described in the general context of program modules that execute in conjunction with an application program that runs on an operating system on a computer system, those skilled in the art will recognize that the disclosure also may be implemented in combination with other program modules. The embodiments described herein may be combined and other embodiments may be utilized without departing from the spirit or scope of the present disclosure. The following detailed description is therefore not to be taken in a limiting sense, and the scope of the invention is defined by the appended claims and their equivalents.

[0025] Embodiments of the present disclosure provide an environment in which multiple users can collaboratively author a document. FIG. 1 illustrates an example authoring system 100 having features that are examples of inventive aspects of the disclosure. The authoring system 100 includes a storage device 120 storing a master copy of a document 150. In one embodiment, the storage device 120 can include a computing device. In another embodiment, the storage device 120 can include one or more storage devices (e.g., a network of computing devices).

[0026] The authoring system 100 also includes at least one user computing device 110 that is communicatively coupled to the storage device 120. Each of the user computing devices 110 can edit the document 150 by creating a user copy 155 of the document 150 and editing the user copy 155. The user copies 155 of the document 150 are synchronized when the user computing devices 110 periodically send to the storage device 120 updates to be shared with the other user computing devices and periodically obtain from the storage device 120 updates from other user computing devices.

[0027] As the term is used herein, a user computing device 110 includes any computing device that obtains a user copy of a document to be authored from a master copy of the document. The user computing device 110 can be different from the storage device 120 or can include a different user account implemented on the storage device 120. In one embodiment, a computing device that acts as a storage device 120 for one document may act as a user computing device 110 for a different document and vice versa.

[0028] In the example shown, four user computing devices 110A, 110B, 110C, and 110D are communicatively coupled to the storage device 120. In other embodiments, however, any number of computing devices 110 may be coupled to the storage device 120. In the example shown, each user computing device 110A, 110B, 110C, 110D can send to the storage device 120 updates generated by the user of the user computing device and can request from the storage device 120 updates generated by the users of the other user computing devices. In one embodiment, the storage device 120

can be a server computing device and the user computing devices 110A, 110B, 110C, 110D can be client computing devices.

[0029] As shown in FIG. 2, the document 150 stored on the storage device 120 can include content 152 and metadata 154. Authoring applications 130 on the user computing devices 110 process and manipulate the content and metadata of the user copies 155 of the document 150. In some embodiments, metadata 154 can be stored separately from content 152. For example, content 152 can be stored in the document 150 and metadata 154 can be stored in a table (see FIG. 7) separate from the document 150. In other embodiments, however, the metadata 154 can be stored within the document 150.

[0030] In general, the user computing devices 110 can synchronize updates to the content 152 separately from updates to the metadata 154. In general, metadata updates 154 are automatically synchronized among the storage device 120 and user computing devices 110, whereas content updates 152 from each user computing device 110 are synchronized at the request of the respective user.

[0031] FIG. 3 is a flowchart illustrating an exemplary synchronization process 300 by which an authoring system 100 can synchronize a copy 155 of a document stored on a user computing device 110 with the master copy 150 of the document stored on the storage device 120. The synchronization process 300 initializes and begins at a start module 302 and proceeds to a first update operation 304.

[0032] The first update operation 304 synchronizes the metadata of the copy 155 with the metadata of the document 150 without requiring any interaction with the user. For example, the first update operation 304 can provide an exchange of metadata between the storage device 120 and the user computing device 110 at periodic time intervals. In one embodiment, the first update operation 304 provides for an exchange of metadata every few seconds. In other embodiments, however, the first update operation 304 can provide for the exchange of metadata to occur in shorter or longer time intervals.

[0033] A request module 306 determines whether a request to synchronize content has been received. For example, the request module 306 can determine whether a user of one of the user computing devices 110 has requested to share content changes with other users. In another embodiment, the request module 306 can determine whether a user of one of the user computing devices 110 has requested to view content changes made by other users.

[0034] If the request module 306 determines that no request to synchronize content has been made, then the synchronization process 300 cycles back to the first update operation 304 and begins again. If the request module 306, however, determines that a request to synchronize content has been received, then the synchronization process 300 proceeds to a second update operation 308, which provides an exchange of content between the storage device 120 and the user computing device 110. The synchronization process 300 completes and ends at a stop module 310.

[0035] As the term is used herein, content updates 152 refer to any addition, deletion, and/or revision made to the substantive content of a document. For example, content updates for a word processing document can include added paragraphs (i.e., or sections thereof), deleted paragraphs (i.e., or section thereof), and/or revised paragraphs (i.e., or sections thereof). In another embodiment, content updates